

ICS 561 – Quantum Algorithms

Term: 221

Section: 01



INSTRUCTOR: Sultan Almuhammadi
OFFICE: 22-316
PHONE: 860-1625
E-MAIL: sultan (@ almuhammadi.com)
COURSE SITE: www.almuhammadi.com/sultanm/ics561 (see also Blackboard)

DESCRIPTION

Searching and sorting algorithms, Complexity analysis, Dynamic programming, Randomized algorithms, Review on Quantum Mechanics, Quantum solutions, Quantum Complexity theory and NP-Completeness, Grover searching algorithm, Fourier transform, Integer Factorization.

PREREQUISITES Graduate standing.

COURSE OBJECTIVES

1. To enhance the students' understanding of various algorithmic techniques and complexity analysis.
2. To provide the students with the design techniques and analysis of quantum algorithms.

COURSE LEARNING OUTCOMES

After completion of this course, the student should be able to:

1. Explain and prove NP-Completeness.
2. Explain foundational concepts in Quantum Complexity theory.
3. Comprehend and apply quantum algorithms to solve hard prob.
4. Analyze the complexity of conventional algorithms.
5. Analyze the complexity of randomized and quantum algorithms.
6. Search and utilize information on conventional and quantum algorithms from a variety of sources.

CONTENTS

The following list is tentative and subjected to changes. Any change will be announced in the course website/Blackboard.

1. Searching and sorting algorithms	1 week
2. Complexity analysis	2 weeks
3. Dynamic programming	2 weeks
4. Review on Quantum Mechanics: Vector Space, Superposition.	1 week
5. Quantum algorithms, Quantum Complexity theory and NP-Completeness	2 weeks
6. Grover searching algorithm	2 weeks
7. Machine learning algorithms	2 weeks
8. Integer factorization algorithms	2 weeks

TEXTBOOKS

- Alsuwaiyel, Algorithms Design Techniques and Analysis, World Scientific, 2016.
- M. Nielsen and I. Chuang, Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press, 2010.

EVALUATION

Coursework:	30%
Project	20%
Midterm Exam	20%
Final Exam (comprehensive)	30%

Course Policies

- **Coursework includes** participation, online/in-class discussions and activities, attendance, homework assignments, quizzes, and projects. Active learning is implemented in this class. Students are expected to be positively engaged in the learning process.
- **Course Website & Participation:** Students are required to periodically check the course website/blackboard and download course material as needed.
 - Several resources will be posted through the website as well.
 - [Blackboard](#) will be used for communication and interaction, posting and submitting assignments, posting grades, posting sample exams, etc.
 - It is expected that you get benefit of the discussion board by raising questions or answering questions put by others.
- **Attendance:** Regular attendance is a university requirement.
 - Attendance will be checked at each lecture.
 - Missing 20% of the classes will result in an automatic **DN grade** (without warning).
 - Late arrivals will disrupt the class session, and may be counted as a miss if repeated.
 - If you find yourself unable to attend a class, email the instructor ahead of time for better planning and management of the class. If you fail to do so, send your email as soon as you get a chance and provide your excuses if any.
 - Every unexcused absence may lead to a loss of 0.5% of total grade.
- **Late assignments:** are subjected to late-penalty. See late submission policy on the course website/ Blackboard under the Assignments page.
- **Re-grading policy:** If you have a complaint about any of your grades, discuss it with the instructor no later than 3 days of distributing the grades (except for the final). Only legitimate concerns on grading should be discussed.
- **Office Hours:**
 - Students are encouraged to use the office hours to clarify any part of the material that is not clear. Use the Blackboard (Bb) or MS Team for quick issues and homework questions.
 - For urgent issues, use emails instead of Bb-mails, please indicate ICS561 in the "Subject" field of your email (e.g. ICS561: Quiz1 score is missing).
- **Academic honesty:**
 - Students are expected to abide by all the university regulations on academic honesty.
 - Cheating will be reported to the Department Chairman.
 - Although collaboration and sharing knowledge is highly encouraged, copying others' work without proper citation, either in part or full, is considered plagiarism. Whenever in doubt, review the university guidelines or consult the instructor.
- **Courtesy:**
 - Students are expected to be courteous toward their classmates and the instructor throughout the duration of this course (in-class and online).
 - Side-talks and text-messages during the class are prohibited.